DOCUMENT RESUME

ED 297 983 SE 049 609

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TITLE Biological Diversity. Global Issues Education Packet.
PUB DATE 86
NOTE 18p.; For other packets in this series see SE 049 606-608. Contains photographs which may not reproduce well.
AVAILABLE FROM Global Tomorrow Coalition, 1325 E Street, NW, Suite 915, Washington, DC 20005 ($7.00 each packet, set of 5 packets $30.00).
PUB TYPE Guides - Classroom Use - Guides (For Teachers) (052)

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS Biological Sciences; *Ecology; Elementary School Science; Elementary Secondary Education; *Endangered Species; *Environmental Education; Instructional Materials; Intermediate Grades; Middle Schools; *Science Activities; Science Education; Secondary School Science
IDENTIFIERS *Extinction (Species)

ABSTRACT

Biological diversity, also commonly called genetic diversity, refers to the variety of organisms on Earth. Scientists are concerned that many species will become extinct because of extensive development in the tropical regions. This packet is designed to increase student's awareness about direct and indirect causes of extinction, endangered species, and the reasons for preserving the genetic diversity of life on Earth. Activities included are: (1) "Variety is the Spice of Life"; (2) "Pave Paradise?"; (3) "Let's Make a Deal"; (4) "Invasion of the Species Snatchers"; and (5) "Talk to the Animals." Each activity includes a brief description, a concept statement, objectives, a list of relevant subject areas and skills, a list of materials, lesson preparation direction, and a suggested procedure. Several of the activities are accompanied by reproducible materials such as game cards. (CW)

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BIOLOGICAL DIVERSITY

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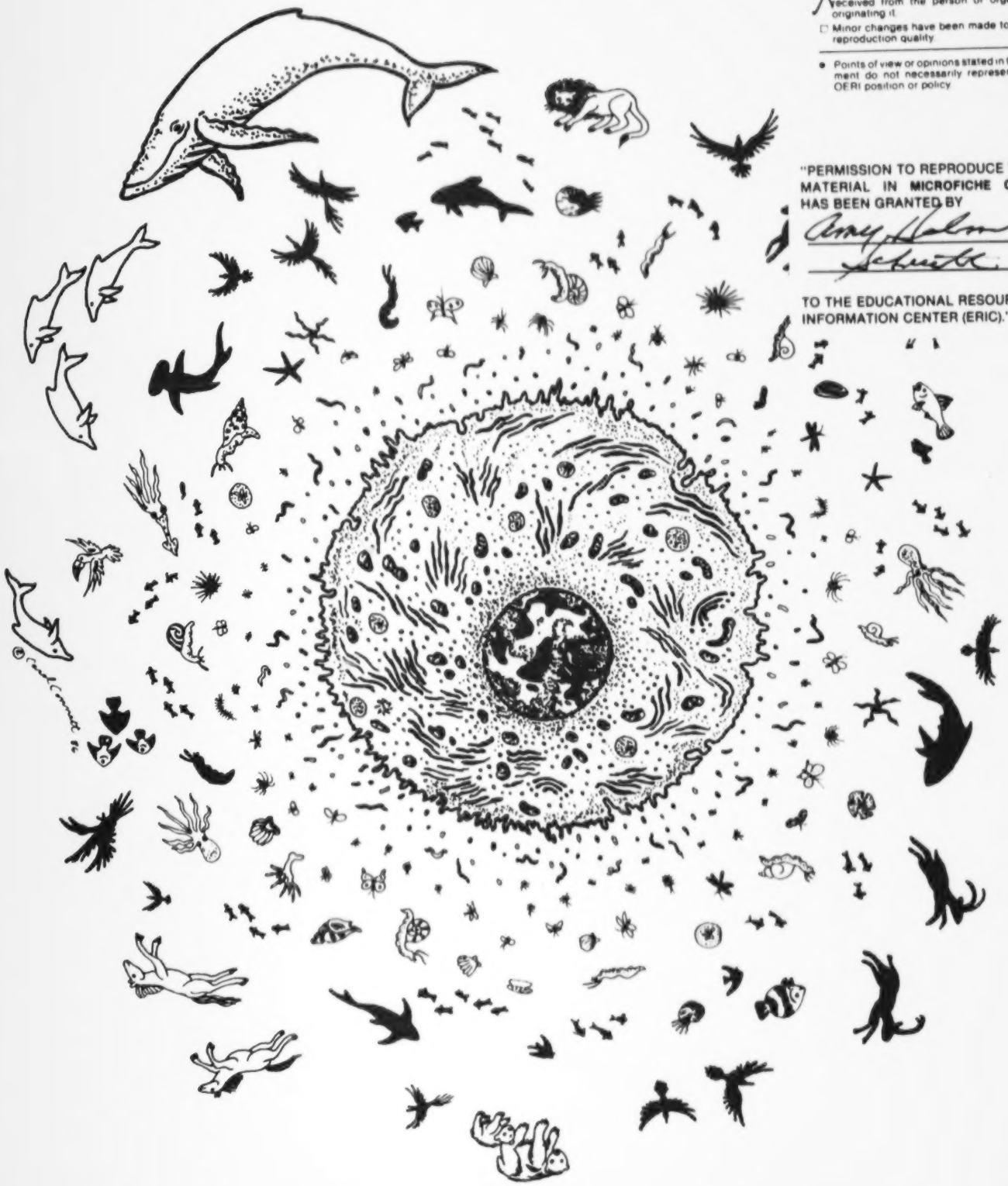

SE 049 609

The educational material was developed by Amy Holm, Education Director, Global Tomorrow Coalition/West. Special thanks to Don Lesh for his editorial comments and prose; Bill and Diane Lowrie for use of their photographs; Carol Connett for her artwork; and to Chris Holden for her lay-out and design skills. All materials printed in this curriculum guide may be reproduced for educational purposes provided acknowledgement is given to the Global Tomorrow Coalition. No reproduction may be made for profit.

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BIOLOGICAL DIVERSITY SUMMARY

The term biological diversity or another commonly used term, genetic diversity, refers to wide variety of plant, animal, and microorganism species that inhabit the Earth. According to Charles Darwin's theory of evolution, species become more and more specialized through genetic change as they slowly adapt to environmental conditions existing over long periods of time. Hence, the diversity of species has continually expanded throughout the millions of years of life on this planet. There are an estimated 10 million species on the Earth, though only one and a half million have been identified and given names. Two-thirds of these species are found in the tropical forests, which scientists believe contain a large proportion of the yet unidentified species. Today scientists are concerned that many species will become extinct even before identification, because of extensive development in the tropical regions.

Extinction, defined as the loss of any one species, has been occurring for millions of years. Though there may be many causes leading to extinction, the species population eventually diminishes to a size at which effective breeding cannot take place. Natural extinctions have occurred as life has evolved on Earth. The most famous extinct animal is, of course, the dinosaur. Species are now disappearing, however, at a higher rate than ever before. Over 1/2 of all species extinctions have occurred in this century. Extinctions will be most numerous in those areas that currently contain the greatest variety of species - the tropical forests and the seas, including the coral reefs.

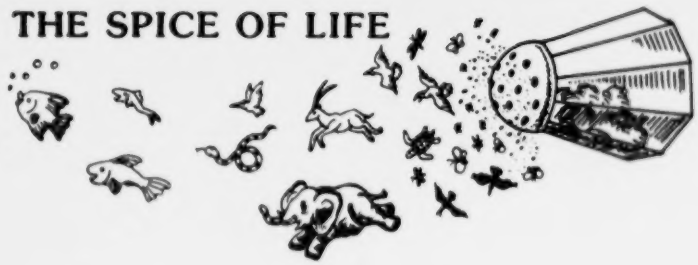
There are both direct and indirect causes of extinction. Direct endangering occurs through overexploitation of the species as a natural resource, predation, wildlife trade, fur business and predator control.

Indirect endangering includes urbanization, development and spread of agriculture, use of pesticides, pollution, deforestation, introduction of an exotic species into an ecosystem, and some types of outdoor recreation. All these factors are augmented by increases in human population. Though some critics scoff at the idea that the removal of one or more species from the Earth's ecosystem will make any difference, the fact is that all living species are interwoven in the ecosystem and no one can predict what the unraveling of one thread will do to the rest of the fabric.

The reasons for preserving the genetic diversity of life on Earth run from the practical to the theoretical. Many people believe that all living beings have a right of existence, no matter how small or insignificant the species may seem to humans. Others feel that the sheer beauty of so many individual species and the aesthetic value that this beauty lends to our lives is important. Various species of plants and animals have different economic or medicinal value and represent a part of the natural resource base of Earth. 40% of modern prescription drugs come from wild species of plants and animals, and the principal U.S. food crops depend on the regular infusion of wild germ plasm to maintain vigor and resistance to insects. Besides these direct benefits of species diversity, each of these life forms has a part to play in the support of life by maintaining soil fertility, recycling nutrients, moderating climates, regulating water flows, filtering pollutants, etc.

Ways of preserving genetic diversity can be divided into two categories: in-situ and ex-situ conservation. In-situ conservation includes establishing gene sanctuaries and biosphere reserves. The five techniques of ex-situ conservation include: seed banks, botanic gardens, pollen banks, tissue cultures, and genetic engineering.

VARIETY IS THE SPICE OF LIFE



By physically placing themselves in categories based on hair and eye color, students can visualize the basic concepts of biological diversity. (30 mins.)

CONCEPT:
Biological diversity means genetic variety, which is the necessary ingredient for sustaining life on this planet.

OBJECTIVES:
(1) Define diversity.
(2) Define biological.
(3) Group selves according to genetic characteristics.
(4) Give (3) examples of benefits of species diversity.

SUBJECT
- Natural Science

SKILLS
- observe
- list
- compare
- hypothesize

MATERIALS
- blackboard/chalk
- paper/pens

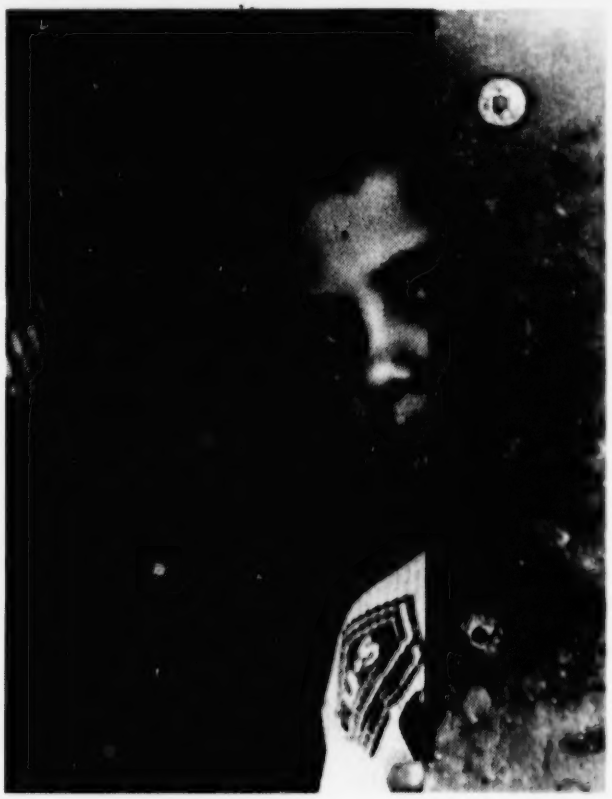
BACKGROUND: None

PROCEDURE:
1. Use the image of the snowflake to define diversity. Each flake is similar in shape and size, but each one is different and unique. Define biological. Living forms on the planet are very diverse also.

2. Exemplify the concept of biological diversity. Instruct the students to stand in any random order. Then tell them to divide into groups, according to eye color; blue, green, or brown. Next tell the students to subdivide the groups by hair color; brown, blond, black, or red. (There is a maximum number of 12 different groups possible.)

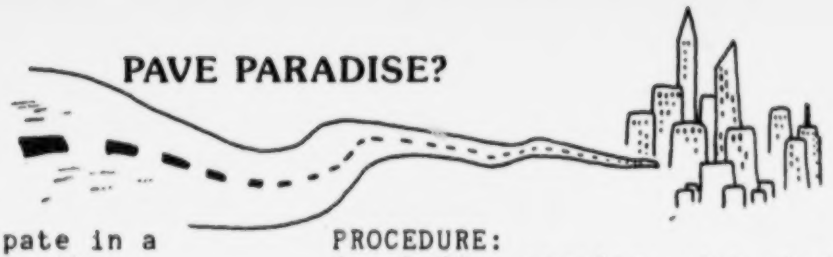
3. While in the groups, explain that there is great diversity within the human species, as shown by the diversity of this small group. Also, there many different species on the Earth, which are as equally diverse!

4. Emphasize that there are differences for important reasons. Give the following example. There are many different varieties of potatoes in the world. If there were only one type (i.e., monoculture) and a particular disease were present, the entire species might be destroyed. And what would happen to all the people that depended on potatoes as their main food?



CONCLUSION:
1. Diversity is our most important natural resource. People depend heavily on the great diversity of plants and animals for many products. For instance, ask each student to list the basic ingredients of their last meal (i.e., milk = cow). Who has the most diverse diet?

PAVE PARADISE?



Students will participate in a group activity based on the childrens game, musical chairs, which will demonstrate how species become endangered or extinct when their habitat is destroyed.(40 mins.)

CONCEPT:
Habitat destruction is a leading factor of endangered or extinct plant and animal species.

OBJECTIVES:
(1) Define species.
(2) Define habitat.
(3) Describe (3) causes of habitat destruction.
(4) Define endanger and extinct.
(5) Describe (3) means of preserving or restoring habitats.

SUBJECT
- Natural Science
- Social Science

SKILLS
- identify
- list
- role-play
- discuss

MATERIALS
- paper • pens • tape • chairs
- record player, tape recorder or musical instrument and music
- Face the Facts Cards*
- Species Cards*

BACKGROUND: See "Variety is the Spice of Life."

PREPARATION:
1. Count the number of students and place the same number of chairs in a circle facing inwards. (18 max.) On the backs of these chairs, tape a sign designating that chair as either a land, air, or water habitat. A fairly even representation of each of the habitats works best for the game.

2. Copy and cut the Species and the Fact cards. Count out the same number of Species Cards as there are students - making sure that there is a mix of species representing the three types of habitat.

PROCEDURE:
1. Define species. Ask students, "What species are we?" Different species live in different homes. Define habitat. Give examples of familiar species and their habitat. e.g. Polar bears in the Arctic. Ask the students to describe their habitat.

2. Inform the students that during the next activity, they will be acting as another type of species. Ask the students how many of them have ever played Musical Chairs? This activity is played in the same way. The circle of chairs represents the Earth. Each chair has a sign on it -- either land, air or water -- which describes one general type of habitat that animals and plants depend on to survive.

3. Give the following directions:
   a) You will be receiving a Species Card. Please read it and identify the proper habitat for your species.
   b) The game will start when everyone is scattered around the inside of the circle and the music begins. You will walk around the circle clockwise until the music stops. Then you need to find a seat with the appropriate habitat sign.
   c) After the first round, I (teacher) will read a Fact Card, which will describe an actual cause of habitat destruction -- and one chair will be removed.
   d) After each round, whoever cannot find a seat will read a Fact Card to the others. Then another chair will be removed and the music will begin again.

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4. Distribute the Species Cards and begin the activity. End the game when all three of the habitats are no longer represented, even if chairs remain in the circle. Explain that species cannot live on Earth without a complete ecosystem. (e.g. Whales live in the oceans, but need air to breathe.)

CONCLUSION:

1. Ask the students to list reasons for habitat destruction, based on the information from the Fact Cards. Define **endangered** and **extinct**. Relate how the destruction of habitats contributes to endangered or extinct species of plants and animals.

2. Brainstorm with the students about ways to preserve habitats or to reconstruct habitats. With each suggestion, return a chair representing a habitat to the circle, until the Earth is a complete and healthy ecosystem again.

SPECIAL SPECIES CARDS

I am a California Condor. My wingspan is 9 feet across. * AIR *	I am a Peregrine Falcon. I travel south during the winter. * AIR *
I am a Wolf. Have you ever heard my howl? * LAND *	I am a Redwood tree. I grow very, very tall. * LAND *
I am a Blue Whale. I grow to be larger than a school bus. * WATER *	I am a Humboldt Penguin. I am a a bird and swim in the ocean. * WATER *
I am a Bald Eagle, the symbol of the United States. * AIR *	I am a Whooping Crane. I am 6 feet tall with a red head. * AIR *
I am Lichen. I help change trees and rocks into soil. * LAND *	I am a Kangaroo. I carry my babies in a pouch. * LAND *
I am a Starfish. I have five arms and live on the seashore. * WATER *	I am Eelgrass - a type of plant that lives in the salty sea. * WATER *
I am a Honeybee. I pollinate flowers and make honey. * AIR *	I am a Swallowtail Butterfly. I eat plants as a caterpillar. * AIR *
I am a Panda, a black and white bear. I eat bamboo shoots. * LAND *	I am a Koala Bear and feed on Eucalyptus leaves. * LAND *
I am a Snail Darter, a 3-inch fish that eats snails. * WATER *	I am a Rainbow Trout, because my scales shine with many colors. * WATER *

FACE THE FACTS CARDS

Human population of the Earth has reached 5 billion. REMOVE A CHAIR MARKED LAND.	A forest fire spread through Borneo destroying 3.5 million hectares of forests in 1983. REMOVE A CHAIR MARKED LAND.
The streets of Times Beach, Missouri were paved with poisonous waste in 1972. REMOVE A CHAIR MARKED LAND.	One billion tons of topsoil flows from Ethiopia each year leading to desertification. REMOVE A CHAIR MARKED LAND.
In 1935, the Hoover Dam was built, flooding the surrounding area. REMOVE A CHAIR MARKED LAND.	25.4 tons of topsoil was lost from the world's croplands in 1985. REMOVE A CHAIR MARKED LAND.
In 1986, a hole in the ozone protective ozone layer, was discovered over the Antarctic. REMOVE A CHAIR MARKED AIR.	A mixture of gases, smoke and soot, called killer smog, caused deaths in London in 1952. REMOVE A CHAIR MARKED AIR.
In 1984, a gas leak in Bhopal, India killed 2,500 people. REMOVE A CHAIR MARKED AIR.	In Europe, 5 million hectares of trees show signs of damage due to air pollution. REMOVE A CHAIR MARKED AIR.
Scientists fear that burning fossil fuels will result in a warming of Earth's climate. REMOVE A CHAIR MARKED AIR.	In 1985, radiation was released from the Chernobyl nuclear reactor in the USSR. REMOVE A CHAIR MARKED AIR.
In 1985, the use of pesticides for farming polluted a bird refuge area in California. REMOVE A CHAIR MARKED WATER.	An oil spill covered 800 sq. miles off the California coast in 1969. REMOVE A CHAIR MARKED WATER.
DDT, a dangerous pesticide banned in the U.S. in 1972, is used by other nations. REMOVE A CHAIR MARKED WATER.	It is estimated that 639,000 plastic containers are dumped into the ocean every day. REMOVE A CHAIR MARKED WATER.
Of the 85,000 lakes in Sweden, 18,000 are dead due to acid rain. REMOVE A CHAIR MARKED WATER.	In China, only 2% of the waste-water discharged into rivers and lakes each year is treated. REMOVE A CHAIR MARKED WATER.

LET'S MAKE A DEAL

Students will begin to understand the important role of the consumer and choices in buying products of endangered plants and animals through comparing exotic and substitute products.(45 mins.)

CONCEPT:
Biological diversity is threatened by the overharvesting of certain species.

OBJECTIVES:
(1) Make a decision as a consumer of plant/animal products.
(2) Define endangered species.

SUBJECT	SKILLS
• Natural Science	• compare
• Economics	• role-play
	• discuss
MATERIALS	• recommend

- Door Prize Cards*
- Question Prize Cards*
- "Inquiring Minds Want To Know" Cards*

BACKGROUND: See "Variety is the Spice of Life" and "Pave Paradise?"

PREPARATION:
1. Copy and cut 3 types of cards.

2. Place the Door Prizes into three different piles on a table in front of the students.

PROCEDURE:
1. Give the following directions:
   a) I will be reading an "Inquiring Minds Want To Know" question about the issue of biological diversity.
   b) Whoever answers it correctly wins a Prize Card - once you receive a Prize Card - you cannot answer anymore questions.
   c) However, you will have <u>one</u> chance to trade your Prize Card for whatever is behind Door #1,2, or 3 later in the game.

2. Begin reading the "Inquiring Minds Want To Know" questions. After some of the students have collected Prize Cards, alternate between asking new questions and allowing the students to trade for <u>one</u> new prize behind one of the doors.

3. Allow <u>all</u> of the students to claim a Prize Card and to trade for a Door Prize, if they choose.

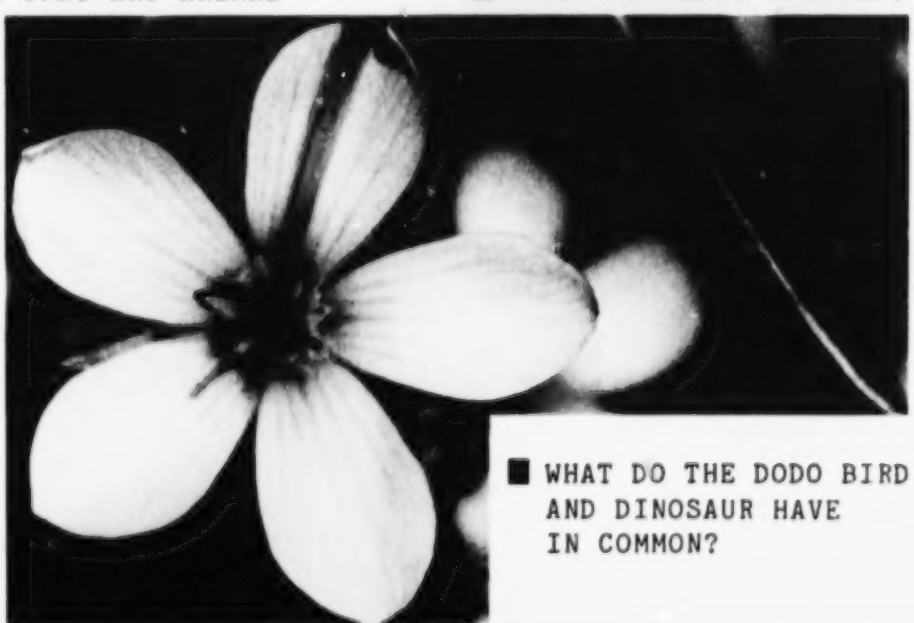
CONCLUSION:
1. Ask students to describe their feelings about their final prize or the choice that they made. What do the prizes have in common? Define **endangered**. One-half of the prizes are made from products of endangered species and the other half represents common substitute items for those same products. Being aware of ones role as a responsible consumer is necessary, because buying products derived from endangered species threatens biological diversity.

+ Often products from endangered species cost more than synthetic or substitute items, because a scarcity in the marketplace of a demanded item will often raise the price. Sponsor an Awareness Day or Week at your school. Demonstrate which consumer demands for products can be filled with less expensive and less endangering substitutes.

"INQUIRING MINDS WANT TO KNOW ..."

- NAME AN ENDANGERED ANIMAL.
- WHAT SPECIES ARE YOU?
- NAME ONE ANIMAL SPECIES.
- DEFINE SPECIES.
- NAME AN EXTINCT ANIMAL.
- DEFINE HABITAT.
- IDENTIFY A CAUSE OF HABITAT DESTRUCTION.
- IDENTIFY ANOTHER.
- IDENTIFY ANOTHER.
- NAME THE HABITAT OF A SHARK.
- IDENTIFY ONE WAY OF HELPING ENDANGERED PLANTS AND ANIMALS.
- IDENTIFY ANOTHER.
- IDENTIFY ANOTHER.

- IDENTIFY ONE THING THAT ANY ANIMAL NEEDS TO SURVIVE.
- NAME ONE PLANT SPECIES.
- IDENTIFY ANOTHER.
- IDENTIFY ANOTHER.
- IDENTIFY ANOTHER.



- DEFINE DIVERSITY.
- WHAT DO THE DODO BIRD AND DINOSAUR HAVE IN COMMON?

QUESTION PRIZES

ALLIGATOR BAG AND SHOES	ELEPHANT FOOT WASTEBASKET	PENGUIN SKIN GLOVES
TOUCAN BILL NECKLACE	TORTOISE SHELL BRACELET	JAGUAR JACKET
TEAK COFFEE TABLE	OSTRICH FEATHER HAT	BEAR CLAW NECKLACE
CONCH SHELL ASHTRAYS	IVORY COMB AND BRUSH SET	SNAKESKIN BOOTS
PARROT FEATHER EARRINGS	MONKEY TEETH NECKLACE	SET OF BUTTERFLY WING DINNER PLATES
COCKATOO IN A GILDED CAGE	LION SKIN RUG	BLACK CORAL NECKLACE
BOTTLE OF PERFUME MADE WITH WHALE OIL	SEAL FUR HAT	RHINOCEROS HORN KNIFE

Door 1	Door 2	Door 3
STRAW HAT	OAK COFFEE TABLE	PINE BOOKCASE
PURE COTTON SWEATER	WOOL GLOVES	STERLING SILVER BRACELET
CLOISONNE EARRINGS	ORIENTAL RUG	WOVEN CLOTH BEDSPREAD
A WOOL COAT	CANVAS TOTE BAG	BLACK VINYL BRIEFCASE
SET OF CLOTH LUGGAGE	STAINLESS STEEL UTENSIL SET	WATERCOLOR OF BIRDS IN TREE
CRYSTAL ASHTRAY	METAL WASTE-BASKET	PLASTIC COMB AND BRUSH SET
WOOL BLANKET	RATTAN CHAIR	HAND-CARVED WOODEN NECKLACE

INVASION OF THE SPECIES SNATCHERS

By conducting a classroom experiment with alien and native plants, students can observe the effects of alien species on the diversity of a particular ecosystem.

CONCEPT:
The invasion of plant and animal species can greatly reduce the biological diversity of an area.

OBJECTIVES:
(1) Understand difference between native and alien species.
(2) Define ecosystem.
(3) Develop hypothesis.
(4) Record observations of experiment.

SUBJECT
- Natural Science
- Math

SKILLS
- observe
- research
- experiment
- compare
- classify
- hypothesize
- evaluate

MATERIALS
- plants
- soil
- water
- trowel
- pot or tray
- Observation Sheets*

BACKGROUND: see "Variety is the Spice of Life."

PREPARATION:
1. Bring plants, soil, trowel, potting tray to the classroom.

2. Contact a local garden club, botanical garden, or native plant society for information on native and alien plants in your region.

PROCEDURE:
1. Define and compare alien and native species. Display a picture or a specimen of a plant or animal native to your region. Ask students to suggest others. Next, display a picture or speciman of an alien plant or animal that has been introduced into your region. Explain how alien species are introduced by a variety of means, including importation of certain species for ornamental purposes and human use.

2. Define ecosystem. Though they may be in an new ecosystem, certain species will thrive very well. Since native plants and animals have not built up defenses to the introduced species, native plants and animals are soon outcompeted for scarce resources or they may even serve as prey. Only a few of the species may be able to survive. Hence, the diversity of the ecosystem has diminished.

3. Remind the students that the same species can be both native and alien. How can this be true?

4. Conduct the following experiment:
   a) Develop an hypothesis for testing the theory of exotic species affecting diversity.
   b) Set up the experiment by filling the tray or pot with soil and placing 4-5 native with 3 alien plants in the container. Place in sunny spot and water when needed.
   c) Students should write daily observations about the state of the plants for three weeks.

CONCLUSION:
1. Following the three-week experiment, compare observation notes. Discuss the results of the experiment. Was the hypothesis proven correct?

OBSERVATION SHEET

	NATIVE PLANTS	ALIEN PLANTS
FIRST WEEK		
SECOND WEEK		
THIRD WEEK		

TALK TO THE ANIMALS

Students will learn about preserving animal species through information sharing and working with group members to devise plans for the long-term survival of three animal species.(50 mins.)

CONCEPT:
Species diversity can be preserved through conservation efforts.

OBJECTIVES:
(1) Define and understand the difference between preservation and conservation.
(2) Develop conservation plan with group members.
(3) List (3) ways of preserving species diversity.

SKILLS	SUBJECT
• identify	• Natural Science
• classify	
• create	MATERIALS
• evaluate	• Animal Cards*

BACKGROUND: See "Variety is the Spice of Life" and "Pave Paradise."

PREPARATION:
1. Copy and cut the Animal Cards.

PROCEDURE:
1. Define preservation. What is the difference between preservation and conservation?

2. Ask the students to tell about the story of the Condor. Use the Condor as an example of how people are trying to preserve an endangered species. Yet the goverment and other organizations cannot even decide on the best way to undertake this task - whether to allow them to remain free in an isolated area or to capture and breed them in captivity until they can be released into the wild again. This task is made even more difficult by the fact that land, air, and water are shared global resources and do not belong to only one nation or species. There is not just one fool-proof method and many facts about the specific species themselves have to be considered carefully.

3. Give the following directions:
a) You will be divided into three groups representing different species; a cheetah, monarch butterfly, and humpback whale.
b) Each student will have an information card on one species. After receiving their cards, the students need to find the other members of their group.
c) Each student should share his or her information with the rest of the group. Then each group needs to work together to develop a preservation plan for their species. Each group will make a presentation to the rest of the class.
d) Remember to consider both the short- and long-term needs of the species for survival.

4. Distribute the Animal Cards and help organize students into their groups.

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CONCLUSION:

1. After each group has presented its plan to the rest of the class, categorize different types of preservation plans (e.g. biosphere reserves) and discuss their advantages/disadvantages.

+ Send your ideas on the preservation of a particular species to experts working in that field or find out what they are doing to help the species. Or contact them to see what you or your classroom can do to help.

For more information on cheetahs:

Laurie Marker
Wildlife Safari
Winston, Oregon 97496

For more information on the Monarch Butterfly:

Melody Allen
The Xerces Society
10 S.W. Ash Street
Portland, Oregon 97204

For more information on the humpback whale:

The Whale Center
3929 Piedmont Avenue
Oakland, California 94611

ANIMAL CARDS

The orange and black make-up of the Monarch Butterfly warns potential predators of its toxicity.	Monarch Butterflies migrate from North to Central America and coastal California in the fall.
The Monarch Butterfly larvae feeds on various species of a plant called "milkweed."	Monarch Butterflies are sensitive to temperature -- they cannot fly below 50 f. and cannot move below 40 f.
Mass gatherings of the Monarch Butterfly on a tree mark a roosting site during overwintering.	A large population of the Monarch Butterfly is needed for survival, because many dangers exist for them.
Destruction of the Monarch Butterfly roosting areas decreased chances of surviving the migration.	There are 45 known Monarch groves in California, though 7 were destroyed by logging in the last two years.
Cheetahs can run up to 70 miles per hour in short bursts. They are the fastest of all 4-legged animals.	Cheetahs hunt by outrunning their prey in open grassland. They could not hunt well in a forested area.
Even when captured as adults, Cheetahs can be easily tamed, but do not breed well in captivity.	Wild Cheetahs can be found in two areas in Africa. It is hunted for being a predator and for its coat.
Cheetahs live in pairs, or in small families, which is led by the strongest male.	Cheetahs cannot compete with larger or fiercer predators for food. Their strength is in their speed.
Cheetah litters contain up to 6 cubs, though only 50% of the newborn survive the first 3 months.	The Cheetah species has little genetic variety, which makes the cats susceptible to diseases.
Humpback Whales do not have teeth. They filter small animals through a plate of fibers called baleen.	There may only be 18,000 Humpback whales in the world -- only 7% of the population before whaling began.
Whales are mammals that breathe air, are warm-blooded, nurse their young, and have body hair.	Whales are killed for many products (e.g., dog food). All these products can be made synthetically.
Humpback Whales migrate to the warm weather on both sides of the Atlantic.	The Humpback Whale is famous for its different songs, which they use to communicate to each other.
The Humpback Whales mate and have their babies in the same area.	Whales send out clicking sounds and listen to return echoes to "see" where they are and what is around.